Studying the Artifacts of Q&A Platforms: The Central Role of the Crowd

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Short Paper

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Abstract

Question and Answer (Q&A) websites serve as a platform that brings together individuals posting questions with those that can provide possible answers to those questions. Since Q&A platforms are human-made information technology (IT) artifacts, this study seeks to better understand how the designed interactive components of a platform, particularly those reflective of the crowd, impact the communication between help seekers (those that post questions) and solution providers (those that provide answers). This study sheds light on the composite role that the formation of questions and answers, along with feedback from the crowd, play in arriving at a validated solution (i.e., accepted answer) for a posed question. Using empirical data from one of the largest Q&A platforms, and applying the novel analytical technique of composite modeling, this study finds that the crowd is central in understanding how answers are perceived on the platform, and how a validated solution crystallizes from the set of answers provided.

Keywords: Q&A Platforms, Composite Modelling, Crowd

Introduction

With the emergence of Web 2.0[1], interactivity has become an integral part of users' engagement with websites. Users are no longer passive consumers of static web pages but are active participants who not only contribute to, but also influence what happens on websites. Writing and posting reviews, along with rating products, are just a few examples of how interactivity turns a static web page into an active one. Web 2.0

[1] The second stage of development of the World Wide Web, characterized by the change from static web pages to dynamic web pages and user-generated content (https://www.dictionary.com/browse/web-2-0).

principles are embedded in almost every website and are an essential ingredient for many online platforms.[2] The attractiveness of such platforms, however, is tightly intertwined with individuals' willingness to contribute to these sites (Aaltonen and Seiler 2016). The more users contribute to a site, the more attractive it is for others to join or return, potentially creating a *crowd*, or a large, frequently open, and rapidly evolving group of users. Engaging the crowd towards a common goal and harnessing its wisdom and/or skills, often referred to as crowdsourcing (Kleeman et al. 2008), is vital. The crowd is able to grow a small idea that an individual has posted online, into something that is large, advanced, and implementable. Likewise, a problem that is perceived as unsolvable by an individual might be solved by the cumulative wisdom of the crowd (Surowiecki 2005). However, the role of the crowd as an entity that has capabilities beyond the sum of individual capabilities, and how this entity might influence behavior inside a platform, is an emerging topic of interest.

In the same manner, the idea that online platforms are man-made artifacts has often been overlooked. Defined as everything that is synthesized by humans (Simon 1969), an *artifact* describes *"a construct, a model, a method, or an instantiation"* (Hevner et al. 2004). In that sense, question and answer (Q&A) platforms are information technology (IT) artifacts,[3] designed to solicit questions and answers via design elements, such as text fields, tags, and voting. One of the most prominent Q&A platforms, Stack Exchange provides an environment where individuals that are passionate about a specific topic, such as computers, can post questions and hopefully receive answers—while monitored and commented upon by the crowd. Q&A platforms often make use of gamification principles to attract and engage contributors. Badges for contributions, and up and down votes are just some of the design options that platforms use to facilitate feedback and engagement (Marder 2015). Using Stack Exchange, we will explore how, and to what extent, the composition of the question, the composition of the answer(s), and the computer-mediated feedback from the crowd influences the resolution of a technology-related problem as a validated solution.

This study will contribute to research in two areas: (1) We will conceptualize and operationalize the notion of a crowd, its influence, and effect on questions, answers, and validated solutions in Q&A platforms; and (2) we will propose a new type of model to be applied to IT artifacts and hypotheses within Q&A platforms.

Literature Review

How Communication Takes Place on Q&A Platforms

Tallman et al. (1993) developed a problem-solving process theory that involves acknowledging a problem, determining if there is motivation to solve it, searching for solutions, selecting a solution, taking an action, evaluating the action, and determining whether to continue. Research has shown that individuals seek information when they encounter a problem (i.e., they observe a mismatch between what is occurring and what should be occurring) (e.g., Altun 2003). Information seeking is an activity that requires effort to acquire information that can be used to solve problems. Effective problem solvers use appropriate sources/channels to meet their information needs, whereas ineffective problem-solvers tend to avoid trying to solve problems and make less use of sources (Heppner et al. 2004).

In this research we focus on two steps in the problem-solving process: searching for solutions and selecting a solution. *"Problem solving in technology-rich environments involves using digital technology, communication tools and networks to acquire and evaluate information, communicate with others and perform practical tasks"* (Xiao et al. 2019, p. 327). Thus, we explore exchanging information in a question-answer style, as in Q&A platforms, as a mechanism of solution search and selecting a solution.

The communication cues conveyed through a Q&A platform are influenced by the design of the platform. In most cases, the platform provides some form of text field for a help seeker to post a question; likewise, it typically provides a text field for a solution provider to post an answer. The help seeker and solution provider are constrained in their communication by the technological elements provided on the platform.

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[2] A platform is a major piece of software on which various smaller application programs can be designed to run (https://www.dictionary.com/browse/software-platform).

[3] An IT artifact can be conceptualized as the application of information technology to enable or support a task embedded within a structure, which is embedded within a context (Benbasat and Zmud 2003).

Therefore, individuals have to be diligent when developing the content of a question/answer. For example, a help seeker composing her question should pinpoint the problem; this includes concisely formulating the nature of the problem, writing the textual portion of the question using proper grammar and spelling, and providing an appropriate question title so that others have an easy way to locate and understand the nature of the question before delving into the body of the question. The better the question is formulated using the technological elements provided, the higher the likelihood that a question will receive a response[4].

A question, once posted on the Q&A platform, is—in and of itself—an artifact. In other words, the designer of a question, while restricted by the platform, tries to mold her question in such a way that it makes a good composition. The relative proportions (or weights) of the various elements of the question determine how "good" or "bad" the question is that just emerged.

This perspective constitutes a fundamental shift in the way we, as IS researchers, can think about computer-mediated communication. In the context of Q&A platforms, a question is more than the text and the text field. It comes to life when a help seeker posts it, and when the crowd reacts to it. The same applies to an answer. It emerges as a construct when an individual provides a response to the question, and when the crowd rates the answer. We should not consider the platform as a static entity that, once designed and implemented, remains unchanged and lifeless. Instead, the platform witnesses a dynamic emergence of questions, answers, and the crowd.

A question may emerge in which its composition is such that the question can be feasibly answered, and if answered, can produce the desired result (e.g., solve problem). After all, the solution provider will only engage in communication if she can understand the message received. A well-composed answer is a subset of all answers posted for a question on a Q&A platform that can be accepted/validated. Since an answer can only be as good as the question posted, not defining the problem concisely in the body of the question or using poor grammar will affect it. Likewise, not stating the question title clearly may redirect the reader to other questions and fail to solicit an answer. Recent research has provided empirical evidence that the voting scores on questions are highly correlated to voting scores on answers (Yao et al. 2015). Similarly, we assert that a well-composed question will facilitate a well-composed answer. We therefore propose the following hypothesis:

H1: The composition of a question posted on a Q&A platform will positively influence the composition of an answer.

As a help seeker has to be diligent about the composition of the question, a solution provider has to be conscientious about formulating a clear and concise answer to convey the content to the help seeker. Like a question, an answer has to concisely formulate the nature of the solution and be written in clear, proper English. Somewhat intuitively, the answer should also match the question. Providing a solution that does not address the problem is likely to be ignored and deemed irrelevant. An answer that represents the best solution to the problem (i.e., best answer to the question) is marked as "accepted" (or validated) by the help seeker, thus indicating that the answer worked (i.e., solved the problem). We infer that a well composed answer will influence the decision of the help seeker in accepting that answer as an accepted/validated solution to her problem. Therefore, we state the following:

H2: The composition of an answer posted on a Q&A platform will positively influence the acceptance of the answer as a validated solution.

The Role of the Crowd in Computer-Mediated Communication

Communication that occurs on Q&A platforms is most often visible to everyone. The crowd is the dynamically formed group of individuals who participate voluntarily in the crowdsourcing problem. They have an influential effect in a Q&A platform, as the crowd collectively decides on the worthiness of a question. The crowd not only witnesses the interaction that takes place on the platform, but also evaluates the communication exchange that takes place. The crowd ensures that a question posted to the platform is of value, is legitimate, and worthy of the time of the community members.

[4] The Stack Exchange platform has an FAQ page that provides a guide for members on how to improve their chances of getting an answer to their question (see https://superuser.com/help/how-to-ask).

By up-voting or down-voting, the crowd determines whether the community should pay attention to and possibly spend the time answering the question. The question can be up-voted, indicating that the question might be interesting and/or important. Likewise, a question can also be down-voted if the crowd deems the question to be irrelevant or too simple. The crowd provides input on the validity of an answer by collectively up or down-voting it, suggesting to the help seeker and others that the solution seems appropriate. While the platform prescribes how users communicate by providing technological artifacts (e.g., text and title fields), the crowd provides feedback on the informational values in those fields.

When a question is posted on the Q&A platform, it sends a signal to the crowd to react. The number of votes, for example, has been used as a measure of the quality of an answer (Burghardt et al. 2017). We argue that the crowd has an impact on the interplay between question and answer, as well as on the interplay between the set of answers provided and the one that is eventually chosen by the help seeker to solve the problem (i.e., the answer that is chosen to be a validated solution). If, for example, the crowd decides to vote down an answer, it might signal that the response is "off-topic", "low quality", and/or "incomplete". In addition, down-voting communicates that a solution is still needed. As a result of this signaling, the crowd will hopefully post additional answers. We therefore propose:

H3a: The crowd moderates the positive relationship between a question and an answer such that positive signals strengthen the relationship.

If an answer has been up-voted in large numbers, the crowd is less inclined to put more effort into formulating additional answers. In cases where the crowd cannot reach a consensus on an answer, members might keep posting answers until the validation of an answer is indicated by the help seeker. Also, whenever multiple answers are proposed in response to a question, the crowd signals to the help seeker through voting which answer is the better solution to the stated problem. In instances where the help seeker is a layperson, the crowd's guidance is often extremely helpful (Burghardt et al. 2017). A feature of Q&A platforms is the best answer annotation - letting help seekers mark one answer as the validated (accepted) solution. This feature ensures that the best answer surfaces to the top and is an asset for those seeking a solution to the same problem in the future (Anderson et al. 2012). We therefore propose:

H3b: The crowd moderates the positive relationship between an answer and a validated solution such that positive signals strengthen the relationship.

Models of the Artificial: Composites

Recent advancements in methodological research have prompted a new class of measurement models to operationalize a new class of constructs. Composite models[5] (Henseler 2017) are being proposed for conceptualizations in which individual pieces combine to form a whole, and the whole is more than the sum of its pieces. Composite modeling is most suitable for constructs that are assembled of components, and the composite forms a distinct entity. Composite models not only capture the influence of each component but also—and more importantly—they capture the influence of the characteristics of the composite entity. The composite model assumes that the composite (i.e., emergent entity) exhibits characteristics that are distinct from its components.

Composite modeling can be viewed as a method between the formative and reflective modeling techniques. Reflective models, for example, assume that indicators are indicative of an underlying latent construct and can be measured with a set of observable measurements that can be substituted for each other. Composites, in contrast, are not latent but can be observed and measured directly, and their components cannot substitute for one another. Formative models, for example, assume that a set of factors cause another factor to vary. They are often used when studying the impact of various dimensions of an overarching concept. With formative models the characteristics of the dimensions also define the concept. The overarching concept exists irrespective of each dimension but is profoundly influenced by the degree each dimension contributes to it. In contrast, in the composite model, the assumption is that the composite is not only different from its characteristics, but that the composite is more than the sum of its components.

[5] Note that prior literature has introduced different terms for this new class of models, such as composite factor models (Henseler et al. 2014), composite-formative models (Bollen and Diamantopoulos 2017), and composite models (Henseler 2017). For this paper, we rely on the simple form - composite model.

Composites have been deemed beneficial for design science research (Henseler 2017) that emphasizes the development and evaluation of IT artifacts (Hevner et al. 2004; Lee et al. 2015). Since Q&A platforms are human-made IT artifacts, the method of composite modeling fits better with this research than the traditional methods involving reflective of formative indicators.

Q&A platforms are built to mimic human interaction and to provide an outlet for questions and answers to be posted, while the crowd is watching and listening. The extent to which it is possible to convey information in the medium, is determined by the way the platform is designed. For Q&A platforms, designers determine what technological artifacts capture a question. For example, they decide that a text field is required where Q&A platform help seekers can enter question text, along with a field for the title of the question to indicate its general content. While building the platform, designers choose how big a text field needs to be for an answer. They also decide to provide voting buttons for each question and answer, allowing platform users to up-vote or down-vote each. Designers may also choose to let help seekers mark an answer as "accepted" or "validated," indicating that the answer provided solved the problem. Overall, the technological components that are representative of the question, those that are representative of the answer, and those that are representative of the crowd, each form composites in their own right.

The Artifacts

At the artifact level, whenever a help seeker poses a question on a Q&A platform, she forms its occurrence and creates a physical manifestation of a specific conceptual question. For example, she has to craft the content of the question using sentences that convey the nature of the problem; she has to craft a title that is indicative of the question; and sometimes she also has to craft tags (keywords). This question artifact is human-made; the platform does not do it. The help seeker is the sole arbiter regarding how the question will look, and merely uses the platform to post the question.

At a technological level, each question is comprised of a title field and a content field. At an ontological level, each question is characterized by the extent to which it is readable, to which it focuses on a specific topic and does not stray in its problem description, and the extent to which a title is chosen that ensures proper categorization of the question and avoids misleading a reader. This set of elements (question title, question body, tags) forms a composite. For a composite construct to emerge, all of its components have to be present. However, they might be present to varying degrees. What distinguishes one question from another is not the presence of each component, but rather the contribution of each of these components to form a coherent whole.

Consider the following thought experiment. If we were to model the question as a reflective construct, we would conceptually assume that the readability of a question, the thematic focus of a question, the thematic focus of a title, and the extent to which the title matches the question are all representations of the “question” artifact. The readability of a question, for example, would tell us everything we need to know about the question, and the readability would be interchangeable with the thematic focus. In contrast, if we were to model the question as a formative construct, we would assume that one component would contribute the same as any other component to the question artifact. So, for example, a question with high readability has the same impact on the concept as a low readability question. Since both operational approaches would not be appropriate, we propose a composite model be considered. In a composite model the composite is a function of the level of each component. So, much like a cookie recipe, not only do the ingredients matter, but the amount of each ingredient used matters. More butter gives you a soft, chewy cookie, whereas less butter gives you a crisp, crunchy cookie.

The same reasoning that applies to a question also applies to an answer in Q&A platforms. Whenever an individual posts an answer, she creates an artifact, a physical manifestation of a conceptual answer. Answers are formed in response to a specific question and attempt to address the question raised by the help seeker. Otherwise, the answer offered would be perceived as outside of the subject domain (i.e., off-topic) and not relevant to what the help seeker is looking for.

Answers, like questions, should use language that is easy to read and understand. This set of components (i.e., readability of an answer, the thematic focus of an answer, and the extent to which the topic of the answer matches the topic of the question) form a composite. What distinguishes one answer from another is not the existence of each component, but the combination of these components to form a coherent whole. Therefore, a well-crafted answer that does not address the question is different from a flawed answer that does address the question.

The Artifact of the Crowd

The crowd, facilitated by technological means such as up-voting or down-voting, influences the interactions that take place between the help seeker and the solution provider on the Q&A platform. The crowd reacts to the questions and the answers, and by doing so, signals help seekers, solution providers and the rest of the crowd what it deems valuable and what it does not.

The influence of the crowd cannot be underestimated. After all, it is the members of the platform who contribute to its existence. Their shared interest, their expertise, and their longing for status drive them to post questions and answers (e.g., Hamari 2017; Feng et al. 2018). By involving themselves in the question-answer (help seeker-solution provider) relationship, the crowd not only evaluates a question or an answer, but also guides it.

The crowd, as the gatekeeper of the information exchange taking place on the Q&A platform, determines what is a well-composed question and answer. For any question posed, members of the platform guide the answers by virtue of voting and steer the help seeker towards the best answer. As such, the crowd determines the survival of questions and answers, as judged by the collective wisdom and expertise of the crowd. The crowd forms a separate entity that would best be modeled as a composite.

Proposed Research Method

To answer our research questions and test our hypotheses, we will use data from one of the most prominent crowdsourced Q&A platforms, Stack Exchange. Within the Stack Exchange network, superuser.com is the third largest site (Chen et al. 2018) and provides questions and answers on topics related to technology. For this study, we chose one segment of supersuser.com that focuses on the topic of Microsoft Windows. We picked this particular topic for multiple reasons. First, the topic was reflective of the current phenomenon that users are increasingly trying to solve their own IT problems (Zaza and Junglas 2016). Second, Microsoft Windows, as one of the most prominent operating systems with a market share of more than 90 percent (Netmarketshare 2019), is prevalent among a broad group of users. Tech-savvy as well as non-tech-savvy users are likely to encounter a problem with Microsoft Windows at some point. Third, and related to the previous point, the category of Microsoft Windows is considered the most prominent community within superuser.com. We collected more than 22,000 questions and answers during a four-month timeframe, spanning September through December 2016.

To operationalize the IT artifacts of a question, answer, and the crowd, we applied the composite modeling technique. The question is a composition of the designed text fields for the question title and the question content. Both text fields in combination capture the manifestation of a particular question and can be measured by observable elements entered into those fields. More specifically, the question is measured by (a) question readability, or the extent to which the wording in the body of the question reads smoothly and is easily understood, (b) question thematic focus, or the extent to which the question articulates/focuses on one topic, (c) question title's thematic focus, or the extent to which the title articulates/focuses on one topic, and (d) the extent to which the topic addressed in the question title matches the topic addressed in the content of the question.

The answer is a composition of the designed text field for the content of the answer. The answer is measured by: (a) answer readability, or the extent to which the answer is easily read and understood, (b) answer thematic focus, or the extent to which the answer articulates one topic, and (c) the extent to which the topic discussed in the answer matches the topic raised in the question.

The crowd is a composition of elements designed as part of the Q&A platform and provides an outlet for the crowd to share, and influence, the question and answer. It is represented as: (a) the number of votes that the crowd provides with regard to the question, and (b) the number of votes that the crowd provides with regard to the answer. The dependent variable, the validated solution, is a dichotomous variable. It captures if a help seeker has agreed that a posted answer can solve the problem by marking it with a green check mark. Our research model is depicted in Figure 1. It uses the notation proposed for composite models in which a hexagon denotes a composite and a rectangular block denotes a component.

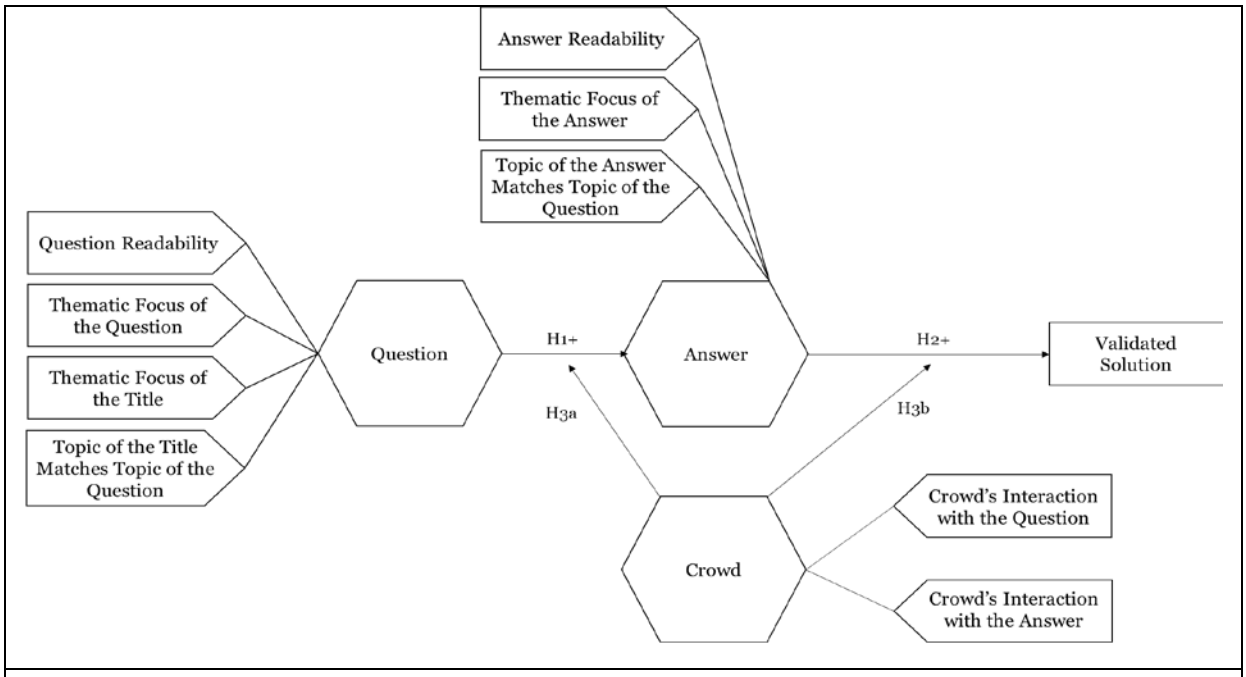

Figure 1. Research Model as a Composite

Analytical Procedures

In this study we use a combination of analytical methods, as depicted in Figure 2 and detailed next.

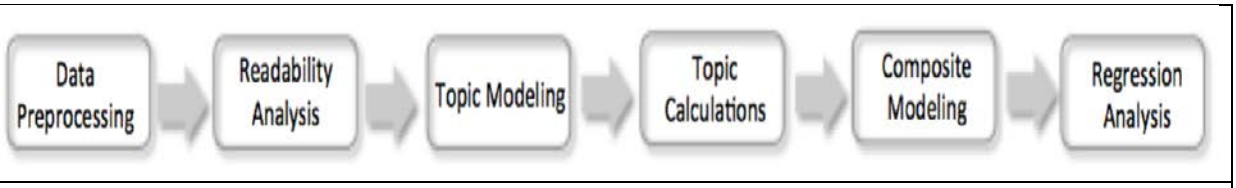

Figure 2. Analytical Procedures

In a first step, data were preprocessed and readied for analysis. This preprocessing included cleaning the data by removing incomplete records. In the second step, the preprocessed data was subjected to a readability analysis. This analysis was conducted using the cloud-based application *readable.io*. Readability was measured using the Flesch Reading Ease Index (Flesch, 1948).

For the third step, we have begun to extract the thematic coverage found in the question title, the question content, and the answer content, using a topic modeling approach. More specifically, we applied a cloud-based tool called *MineMyText* (available at http://www.minemytext.com/). We removed all HTML tags, as well as all numbers, from the text. We also excluded all uninformative words that were found frequently, such as "windows," "use," and "computer." All words were consistently reduced to their dictionary form. Multiple iterations were applied to determine the most suitable number of topics (i.e., 10) to be extracted (e.g., Bouma 2009; Lau et al. 2014). The ten-topic model yielded topic themes that were most pronounced and most distinguishable when compared to models with a higher and lower number of topics. Table 1 provides an excerpt from the topic modeling analysis. Topic one is characterized by the words "user," "folder," "account," "access," "password," "permission," "share," "administrator," "log," and "run" based on their frequency of occurrence in the texts (the innermost ring of the word cloud in Table 1). Using the most frequently occurring words, along with reading through the documents associated with the topic (provided

by MineMyText) (see Document content excerpt in Table 1) allows inferences to be made about the semantic meaning of the topic. It was determined that the first topic addresses problems with user account access permissions in Windows (see Interpretation of the topic in Table 1).

Topic ID	Most frequently occurring words	Word cloud	Document content excerpt	Interpretation of the topic
1	User, folder, account, access, password, permission, share, administrator, log, run		The key is to use the advanced permissions dialog as well as specifying the scope of the permission change and applying a permission set to the CREATOR OWNER of the folder ...	Problem with user account access permissions in Windows

Table 1. Sample of Topic Modeling Results

Next Steps

Next, we will perform composite modeling on the topics identified. This will begin with topical calculations (Step 4 in Figure 2). Composite modeling requires two competing models—a composite and a reflective model—to validate the appropriateness of the composite model. After the composite model and reflective model have been developed, we will analyze the structural model using ADANCO[6] (version 2.0.1) and logistic regression[7]. The imported standardized scores of the composites from ADANCO will be used as input into SPSS for further analysis.

Research Implications

According to Gregor and Hevner (2013, p. 341) the type of design-science research detailed here is classified as an *improvement* (high on application domain maturity and low on solution maturity) and consists of developing new solutions for known problems. In addition, it provides a research opportunity and knowledge contribution for researchers. Q&A platforms are IT artifacts, designed with questions and answers in mind. What is different is that the crowd bears witness to the communication that takes place on the platform and potentially influences the communication dynamics. This study will show how the crowd takes on gestalt based on the design elements of the platform, and how this gestalt interacts with other platform design elements that are representative of the questions and the answers. Prescriptive knowledge in design-science research includes constructs as well as methods (Gregor and Hevner 2013). By conceptualizing the constructs of questions, answers, and the crowd as human-made composites, we will also be able to use one of the latest analytical techniques, composite modeling as a more finely grained tool for exploring this domain.

References

Aaltonen, A., and Seiler, S. 2016. "Cumulative Growth in User-Generated Content Production: Evidence from Wikipedia," *Management Science* (62:7), pp. 2054-2069.

[6] Developed by Jörg Henseler and Theo K. Dijkstra (2015).

[7] The "validated solution" is dichotomous, and ADANCI does not support dichotomous dependent variables.

Altun, I. 2003. "The Perceived Problem-Solving Ability and Values of Student Nurses and Midwives," *Nurse Education Today* (23: 8), pp. 575– 584.

Anderson, A., Huttenlocher, D., Kleinberg, J., and Leskovec, J. 2012. "Discovering Value from Community Activity on Focused Question Answering Sites," In *Proceedings of the 18th ACM SIGKDD International Conference on Knowledge Discovery and Data Mining*, Beijing, China, pp. 850-858.

Benbasat, I., and Zmud, R.W. 2003. "The Identify Crisis within the IS Discipline: Defining and Communicating the Discipline's Core Properties," *MIS Quarterly* (27:2), pp. 183-194.

Bollen, K. A., and Diamantopoulos, A. 2017. "In Defense of Causal-formative Indicators: A Minority Report," *Psychological Methods* (22:3), pp. 581-596.

Bouma, G. 2009. "Normalized (Pointwise) Mutual Information in Collocation Extraction," *In Proceedings of the Biennial GSCL Conference*, Potsdam, Germany, pp. 31–40.

Burghardt, K., Alsina, E.F., Girvan, M., Rand, W., and Lerman, K. 2017. "The Myopia of Crowds: Cognitive Load and Collective Evaluation of Answers on Stack Exchange," *PLOS ONE* (12:3), pp. 1-19.

Chen, W., Wei, X., and Zhu, K. 2018. "Engaging Voluntary Contributions in Online Communities: A Hidden Markov Model," *MIS Quarterly* (42:1), pp. 83-100.

Feng, Y., Ye, H., Yu, Y., Yang, C., and Cui, T. 2018. "Gamification Artifacts and Crowdsourcing Participation: Examining the Mediating Role of Intrinsic Motivations," *Computers in Human Behavior* (81), pp. 124-136.

Flesch, R. 1948. "A New Readability Yardstick," *Journal of Applied Psychology* (32), pp. 221–233.

Gregor, S., and Hevner, A.R. 2013. "Positioning and Presenting Design Science Research for Maximum Impact," *MIS Quarterly* (37:1), pp. 337–361.

Hamari, J. 2017. "Do Badges Increase User Activity? A Field Experiment on the Effects of Gamification," *Computers in Human Behavior* (71), pp. 469-478.

Henseler, J. 2017. "Empirical Advertising Research at the Interface of Design and Behavioral Research," *Journal of Advertising* (*46:*1), pp. 178–192.

Henseler, J., Dijkstra, T. K., Sarstedt, M., Ringle, C. M., Diamantopoulos, A., Straub, D. W., and Calantone, R. J. 2014. "Common Beliefs and Reality About PLS: Comments on Rönkkö and Evermann (2013)," *Organizational Research Methods* (17:2), pp. 182–209.

Heppner, P. P., Witty, T. E., and Dixon, W. A. 2004. "Problem-solving Appraisal and Human Adjustment: A Review of 20 Years of Research Using the Problem-solving Inventory," *The Counseling Psychologist* (32: 3), pp. 344– 428.

Hevner, A.R., March, S.T., Park, J., and Ram, S. 2004. "Design Science in Information Systems Research," *MIS Quarterly* (28:1), pp. 75–105.

Kleeman F, Voss, G., and Rieder K. 2008. "Un(der)paid Innovators: The Commercial Utilization of Consumer Work Through Crowdsourcing," *Science, Technology and Innovation Studies* (4:1), pp. 5–26.

Lau, J., Newman, D., and Baldwin, T. 2014. "Machine Reading Tea Leaves: Automatically Evaluating Topic Coherence and Topic Model Quality," In *Proceedings of the European Chapter of the Association for Computer Linguistics*, Gothenburg, Sweden, pp. 530-539.

Lee, A., Thomas, M., and Baskerville, R. 2015. "Going Back to Basics in Design Science: From the Information Technology Artifact to the Information Systems Artifact," *Information Systems Journal* (25:1), pp. 5-21.

Marder, A. 2015. "Stack Overflow Badges and User Behavior: An Econometric Approach," In *Proceedings of IEEE/ACM 12th Working Conference on Mining Software Repositories*, Florence, Italy, pp. 450-453.

Simon, H. A. 1969. *The Sciences of the Artificial*. Cambridge: MIT Press.

Surowiecki, J. 2005. *The Wisdom of Crowds*. Anchor Books, New York.

Tallman, I., Leik, R. K., Gray, L. N., and Stafford, M. C. 1993. "A Theory of Problem-solving Behavior," *Social Psychology Quarterly* (56:3), pp. 157–177.

Xiao, F., Barnard-Brak, L., Lan, W., and Burley, H. 2019. "Examining Problem-solving Skills in Technology-rich Environments as Related to Numeracy and Literacy," *International Journal of Lifelong Education* (38:3), pp. 327-338.

Yao, Y., Tong, H., Xie, T., Akoglu, L., Xu, F., and Lu, J. 2015. "Detecting High-quality Posts in Community Question answering sites," *Information Sciences* (302:1), pp. 70-82.

Zaza, I., and Junglas, I. 2016. "IT Self-Service Engagement: A Theory of Trying Perspective," In *Proceeding of the International Conference on Information Systems*, December 11-14, Dublin, Ireland, pp. 1-21.